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Pelegrín, Angels; Bolancé, Catalina

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REGIONAL FOREIGN DIRECT INVESTMENT IN MANUFACTURING. DO AGGLOMERATION ECONOMIES MATTER?

Authors and Address:

Angels Pelegrín

apelegrin@ub.edu

Barcelona Institute of Economics

University of Barcelona

Catalina Bolancé

bolance@ub.edu

Dep. Econometrics, RFA-IREA

University of Barcelona

Avda. Diagonal nº 690, 08034 Barcelona, Spain

PHONE: (34) 93.402.19.88,

FAX: (34) 93.402.18.21,

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Abstract

This paper examines the role played by agglomeration economies as location determinants of regional foreign direct investment in manufacturing. The analysis reveals that foreign direct investment location is dependent on specific industry traits, and that agglomeration economies appear as the strongest pull factors. The model, estimated with panel data, finds evidence, first, that industries with a high level of linkages are attracted to regions with high manufacturing activity; and, second, that

locations which accumulate R+D activities attract chemical industries. Finally, cost-oriented industries do not value agglomeration economies and their localization emerges due to endowment reasons.

Key Words: Foreign Direct Investment, Agglomeration Economies, Regional Manufacturing Location, Industry traits, Panel data.

JEL: R12, F21, F23

INTRODUCTION

Agglomeration economies are considered a key issue in foreign direct investment (FDI) and the literature has tended to focus on agglomeration effects as determinants of industrial location (MARSHALL, 1920; HOOVER, 1936; ARROW, 1962; ROMER, 1986; JACOBS, 1969; KRUGMAN, 1991; AUDRETSCH, 1998; FUJITA, KRUGMAN and VENABLES, 1999 are good examples).

Indeed, a sizeable number of studies have revealed the tendency of foreign investment to agglomerate (WOODWARD, 1992; HEAD et al., 1999; GUIMARAES et al., 2000; DRIFFIELD and MUNDAY, 2000, CROZET et al., 2004; CANTWELL and PISCITELLO, 2005, among others). However, little is known about the relative importance of agglomeration factors in attracting FDI. The results presented here seek to provide some insight to the following questions: Are agglomeration effects significant location determinants? Are all industries attracted by the same agglomeration effects, or do the powers of attraction of agglomeration economies vary according to the specific traits of an industrial sector? And what are the main determinants of regional location for each industry?.

The aim of this paper is to explore the way in which inter-industry differences and agglomeration economies interact in the location of FDI. To do so, the paper seeks to compare the relative regional concentrations of manufacturing FDI, on the one hand, and those of Spanish manufacturing industry, on the other. On revealing differences in these respective regional agglomerations, we seek to establish associations between certain features of industries (linkages, R+D intensity, and costs) and the relative importance of agglomeration economies (manufacturing activity, concentration of services and regional R+D activities).

To date, very few studies have attempted to analyse the role of agglomeration economies as location determinants across the industries. LUGER and SHETTY (1985) studied the effect of certain agglomeration economies on three industries. SMITH and FLORIDA (1994) examined the role of linkages in the location of the Japanese automotive-related industries in the USA. KUEMMERLE (1999) focused on the determinants of FDI in the R&D laboratories of the pharmaceutical and electronics industries. Similarly, CHUNG and ALCÁCER (2002) analysed the capacity of state technical capabilities to attract FDI in four research-intensive industries. However, these papers only study limited aspects of the relationship between agglomeration and industries, whereas here we wish to analyse the capacity of industry traits in determining the power of attraction of agglomeration economies in the regional location of FDI.

Clearly, an understanding of such matters is crucial for regional policy makers and for firms. For policy makers concerned with regional promotion, the attraction of FDI has traditionally been a way of increasing productivity and creating new jobs. Information about which industries show most significant agglomeration effects is therefore essential in order to attract a primary group of firms that can generate a self-reinforcing process of agglomeration, in which more firms will follow. At the same time, an awareness of the main industry-specific determinants of FDI location is basic for the implementation of regional policies that can address the needs of different industries and make the appropriate investment in infrastructure so as to increase the attractiveness of the region. For new entrants having to make such strategic decisions, being in possession of information about the main factors determining location in their industry is particularly valuable.

This paper assumes that firms maximize profit, which is dependent on a range of regional characteristics that include technical activity, market size, endowment factors and agglomeration economies. The value attached to each of these attributes of location is, therefore, a particular function of the traits of each industry.

With the aim of verifying whether agglomeration economies have a significant effect on FDI, an econometric model is estimated here across five different industries in the Spanish economy. Given that we have access to panel data, as well as cross-sectional information for different geographical areas (17 regions) and temporal information for the period 1995-2000, the methodology adopted in estimating the model is that specifically designed for panel data (BALTAGI, 2001).

Our empirical results indicate that the main agglomeration effect in determining location is the presence of the same industry activity in the territory. This suggests that regions with the capability to develop intra-industry spillovers are more likely to attract FDI and that industries with a high level of linkages are attracted to regions with a high degree of manufacturing activity. Further, locations in which R+D activities agglomerate attract high technology-intensive industries. We also find that the location pattern of R+D-intensive industries are consistent with the MAR approach (Marshall, Arrow and Romer), as all of them show positive and significant location economies. Finally, cost-oriented industries do not to value agglomeration economies, being attracted to regions with favourable factor endowments.

The paper is divided into five sections. Following on from this introduction, section two outlines the theoretical approach adopted here and the main hypotheses we seek to test. The third section describes the variables used in the econometric model. The fourth section presents the econometric methodology for panel data analysis and reports the estimation results. The final section offers a summary and draws conclusions.

AGGLOMERATION ECONOMIES AND INDUSTRY TRAITS IN FDI

Patterns of industrial location and specialization are determined by the interactions between the characteristics of an industry and those of the regions. Thus, while factor abundance differs geographically, industries also differ in their factor intensity. Among these regional characteristics, agglomeration economies are a determining factor in the attraction of FDI. Following MARSHALL's (1920) early contribution, various approaches have been adopted in identifying external economies that generate agglomeration. This section focuses on a firm's linkages and industry intensity in technology as key traits leading to such geographical concentration.

MARSHALL identified three types of external economies that generate such concentration: specialized labor, specific inputs and technological spillovers. For firms, being able to call on a low-cost, qualified labor supply within the same territory constitutes an external economy; for workers, the concentration of firms within the same sector implies a reduction in uncertainty as the risk of unemployment is not so great. At the same time, the existence of a large, local market creates a cluster of specialized input suppliers. Market size is clearly a fundamental factor in the appearance of specialized firms operating in complementary activities, which generate productive relationships between the firms: backward and forward linkages. Finally, technological spillovers, derived from knowledge and information about the innovations produced in the area, benefit all firms located in the same territory.

Subsequently, a number of approaches have been adopted in studying agglomerations. New economic geography, for example, centres itself around MARSHALL's identification of a firm's linkages, but also draws on other elements such as increasing returns, transport costs and factor mobility. As these elements interact, industry will either agglomerate or become dispersed in space.

FUJITA, KRUGMAN and VENABLES (1999) have identified the main centripetal forces leading to spatial agglomeration as: 1) linkages: forward and backward, 2) thick markets and, 3) knowledge spillovers. Similarly, they identify the main centrifugal forces as: 1) immobile factors and, 2) congestion diseconomies. These forces were introduced in the core-periphery model (KRUGMAN, 1991), in which the immobility of farmers acts as a centrifugal force, whereas the centripetal force is generated through a circular causation of factors. Initially, the concentration of firms leads to greater variety, to higher real incomes for workers (who also act as consumers) and, consequently, to the migration of more workers into the area. Then, the larger market created by the increase in the number of workers and the existence of economies of scale and transport costs create incentives to concentrate in the region with the larger market. As FUJITA and KRUGMAN (2004) claim: "In short, the centripetal force is generated through a circular causation of forward linkages (the incentive of workers to be close to the producers of consumer goods) and backward linkages (the incentive for producers to concentrate where the market is larger)". In a world in which transport costs are declining and increasing returns are of growing importance, forward and backward linkages can generate a process of agglomeration whereby producers wish to locate near their suppliers and customers and, therefore, near to one another. However, the immobility of certain resources, frequently land and labor (international cases), and congestion costs can act as powerful centrifugal forces resulting in the dispersal of firms in space.

Another approach focuses on industrial clusters, in which firms benefit from locating near to each other because of knowledge spillovers. Just as geographic proximity is significant in transmitting knowledge, location in an area of scientific and technological assets ensures access to spillovers of economic knowledge. The regional promotion of knowledge spillovers and how they operate is subject to various interpretations. The MAR externalities model - based on the combined approaches of MARSHALL (1920), ARROW (1962) and ROMER (1986) - assumes that most learning and knowledge spillovers take place within a particular industry. The concentration of the industry promotes knowledge spillovers between firms thereby facilitating innovative activity. An important assumption of the model is that knowledge externalities only exist for firms in the same industry. By contrast, JACOBS (1969) argues that the most significant knowledge spillovers are external to the industry in which the firm operates. This exchange of complementary knowledge across a range of firms and economic agents forms the basis of innovation. Furthermore, cities are an important source of knowledge externalities because typically the diversity of their knowledge sources is much greater. JACOBS (1969) claims that the more varied the industries in a region, the greater is the generation of knowledge spillovers, innovative activity and economic growth.

In the literature on the determinants of multinational activity, DUNNING's "Eclectic Paradigm" suggests that an enterprise's FDI is determined by three types of potential advantage: ownership-location-internalisation (OLI) advantages (DUNNING, 1981). In other words, FDI is determined, first, by the extent to which the enterprise possesses net ownership advantages (HYMER, 1960); second, the extent to which it is able to internalise these advantages or, on the contrary, must leave them for other enterprises to exploit (BUCKLEY & CASSON, 1976); and, third, the profitability of locating its production units either at home or abroad (VERNON, 1966).

Under the theory of internalisation, the role of the R&D expenditures by subsidiaries abroad is mainly to help the firm to adapt the technologies created at home to the conditions of the host country in order to better adjust existing products to local needs. KUEMMERLE (1999) calls this kind of FDI home-base-exploiting (HBE) investment.

An alternative view suggests that the emergence of intellectual capital as a key strategic asset in the wealth creation process represents one of the most significant changes in the last two decades. DUNNING (1998) claims that a recent change in the reasons underlying FDI is the growth in strategic asset-seeking FDI[1], aimed at protecting or increasing the ownership advantage of the investing firm, rather than at exploiting this advantage as is the case of traditional FDI. Thus, the location preferences of firms have shifted from traditional requirements, such as access to markets and natural resources, to the need to have access to knowledge-intensive assets, confined mainly to developed countries, and which are characterized by a greater geographical concentration than other kinds of activity, KUEMMERLE (1999) calls this kind of FDI home-base-augmenting (HBA) investment.

KUEMMERLE (1999) examines the determinants of FDI in R+D laboratories by pharmaceutical and electronic multinational companies with the assumption that there might be a dichotomous set of motives for de dispersion of R&D activities. The author finds that laboratories whose main purpose is to exploit their existing firm-specific advantages (HBE) look for countries that offer market opportunities, while laboratories whose aim is to augment their firm-specific advantages (HBA) are attracted to countries with a relatively strong scientific base.

However, the distinction between these two types of FDI in R&D activities seems not to be as dichotomous as it has been shown. LE BAS and SIERRA (2002) use an index of revealed technological advantage to evaluate the locational strategies of large firms' technological activities. Using data from the European Patent Office, the authors find that in 70% of cases, the multinationals locate their activities abroad in technological areas where they are strong at home (HBA and HBE). Moreover, HBA outclasses HBE (35.5% of cases compared to 31% respectively) and becomes more important as time passes. Although HBA is dominant, firms use both types of strategies. The authors conclude that at the core of both strategies one finds the advantages built at home, which show the national system of innovation.

CRISCUOLO et al. (2005) distinguish two primary types of activities to explain the location of R&D activities of firms. One type is asset-exploiting R&D activity, when firms seek to promote the use of their technological assets in a foreign location. The activities usually involve the modification of the products or processes in order to adapt them to local conditions; this concept is similar to the KUEMMERLE's HBE. In this case the technological advantages of the firm reflect those of the home country's innovation system, not only the parent company's technological assets. The second type is asset-augmenting R&D activity, when firms aim to improve, to acquire, or to create new technological assets. In this case the determinant for foreign location is access to location-specific advantages not available in the home base; this concept is very similar to the KUEMMERLE's HBA.

The authors question whether or not knowledge spillovers, of both types, depend on geographical distance. They consider that some facts, such as the tacit nature of knowledge and the existence of a common pool of resources in a region make spillovers more intense for firms located in that region, being a focus for asset-augmenting R&D activities, and augmenting the local knowledge base. Using patent citation data the authors prove that European multinationals in the US and US multinationals in Europe rely extensively on home region knowledge sources, that is, asset-exploiting activities remain very important, although the asset-augmenting R&D activities from European firms into the US are, in many cases, as frequent as the asset-exploiting activities, that is, most of the firms engage in both types of activities.

NARULA and ZANFEI (2004) also consider that asset-exploiting and asset-augmenting activities are the main motives of offshore R&D investment. The asset-augmenting perspective considers local context as sources of competencies and of technological opportunities. The main idea is that the foundations of competitive advantage no longer reside in one country, but in many. Innovation systems and the industrial and technological specialisation of countries change much more slowly than the needs of firms. Thus, in addition to proximity to markets, firms invest abroad to seek new sources of knowledge, which are associated with the innovation system of the host region.

After a review of the main empirical studies, the authors point out that even though the conceptual differences are clear; indicators of the importance of these two motives of R&D investments are scarce.

Another relevant strand of literature in this area stresses the importance of the local innovation system when studying the pattern of knowledge flows. MAURSETH and VERSPAGEN (2002) investigate the determinants of knowledge flows using patent citations between European regions. The authors find that the clustering of knowledge generation activities is a relevant phenomenon. Their results indicate that geographical distance has a negative impact on knowledge flows, while sharing the same language and belonging to the same country increases the knowledge flows. At the same time, knowledge flows are industry specific and they are usually more frequent in industries with specific technological linkages between them. So the local innovation system is determinant in the technological competence of firms.

CANTWELL and IAMMARINO (2003) study in depth the relationships between the globalisation of technological innovation by multinationals and regional systems of innovation in Europe. The regional dimension of innovative process is central to explain the locational choices of multinational corporations. This increasing importance of regions can be explained by the relations with the sources of information external to the firm, which are strongly influenced by spatial proximity, and the use of informal channels for knowledge diffusion (tacit knowledge).

The authors summarise the different patterns of knowledge flows backwards and forwards, within and outside the multinationals, and conclude that inter-border corporate integration and intra-border sectoral integration seem to strengthen technological linkages and specialisation between regions. The authors distinguish between higher order and intermediate regional centres of technological excellence. Higher order cores are a source of general expertise and skills and attract foreign research that has a more pronounced exploratory nature. This locations show a great dynamism in technological and services activities, general infrastructure, financial facilities, openness to external networks, business climate and corporate culture. Intermediate locations are sources of specific capabilities in some particular field, in which the attraction of foreign resources is likely to be motivated by asset-seeking large firms. These regions might be negatively affected as foreign affiliates could appropriate their indigenous expertise and displace the local firms out of the market, as a result the position of the region in the hierarchy would drop.

CANTWELL and IAMMARINO (2003) use patent data in the US to analyse the location of technological activity in 69 regions belonging to seven EU member states. Regional profiles of specialisation are rooted in local environment and foreign research activities by multinationals depend upon their technological profiles and strategies, as well as upon the characteristics of regional systems. Therefore, the authors find that: first, some regional systems of innovation display rather fast multinational technological growth, particularly in industry clusters and in some prosperous metropolitan systems, while others, even traditionally innovative cores, suffer a relative stagnation or decline. Second, that European integration has gone hand-in-hand with the globalisation of firms, spurring interdependence within firms and deepening the degree of agglomeration in the EU area. Finally, there is a remarkable variety in national patterns supporting the presence of a ranking among European national innovation systems.

An additional source of FDI agglomeration effects lies in the asymmetry of information. Unlike domestic investors, foreign investors face substantial asymmetry of information. A rational response to the cost of information and to business uncertainty is to locate in those specific areas where the cost of information can be minimized. This means that the assets of foreign firms tend to be more concentrated than those of local firms. From the mid-1990s onwards, information has become increasingly more important in the decisions of multinationals when choosing a location in a host economy (MARIOTTI and PISCITELLO, 1995; HE, 2002). Something similar happens when firms engage in R&D in a foreign location aiming to internalise several aspects of the host location system's. The high cost of becoming familiar with and integrating into a new location is expensive and time consuming (CRISCUOLO et al; 2005).

Therefore, all these studies highlight three main features: the first one is the importance of two motives, asset-exploiting or HBE and asset-augmenting or HBA, to explain the location of R&D activities abroad. Secondly, these two motives are not mutually exclusive and most firms engage in both types of activities, and finally, the innovation system of the host region plays an important role in the pattern of knowledge flows.

On industry analysis one empirical contribution is made by CHUNG and ALCÁCER (2002), who study FDI in manufacturing by OECD nations in the United States showing that knowledge-seeking activity is limited specifically to R+D-intensive industries. Foreign firms investing in pharmaceuticals, semiconductors and electronics presented positive valuations, but with the exception of these industries, knowledge seeking was found not to be prevalent across industries.

A number of studies have sought to prove that specific FDI agglomeration economies can be identified. These specific economies can, it is claimed, be determined by their specific industry traits, for example SMITH and FLORIDA (1994) found that the proximity of Japanese-affiliated assembly plants is an important element in the location decision of Japanese-affiliated manufacturing establishments in automotive-related industries. HEAD et al. (1995 and 1999) showed that Japanese ventures do not simply mimic the geographical pattern of the U.S. establishments in their industry, their location being significantly influenced by the locations of previous Japanese investments in the same industry and/or group (Keiretsu). SHAVER (1998) found that foreign-owned firms favour coastal states more than their US-owned counterparts. The author suggests that this difference arises from the higher import intensity of foreign-owned establishments and so they tend to locate in areas where it is more cost effective to receive imports.[2]

New economic geography has described the way in which forward and backward linkages - the centripetal forces - can generate a process of agglomeration whereby producers wish to locate near their suppliers and customers so as to minimize transport costs. Thus, industries with high levels of intra-industry and inter-industry linkages will tend to locate near other producers in order to buy intermediate goods and to sell their products.

From this discussion, our first hypothesis can be stated as:

> H_1: Foreign direct investment in industries characterized by high levels of intra-industry and inter-industry linkages is positively attracted to host country regions characterized by high producer activity.

At the same time, geographic proximity promotes knowledge spillovers between firms; therefore location in an area of scientific and technological assets ensures access to the host region innovation system. Firms seeking knowledge spillovers will value locations that offer more technical activity, that is, regions in which there are more scientists, engineers, more patents, and greater R+D intensity. The firms most likely to value these regional characteristics positively are firms in R+D-intensive industries, where technical progress is critical. Therefore, the second hypothesis can be stated as follows:

> H_2: Foreign direct investment in industries characterized by high levels of technology is positively attracted to host country regions characterized by high R+D density.

Here, our main assumption is that the role played by agglomeration economies as location determinants will depend on the specific traits of the industries. Industries that are particularly intensive in any one given factor are attracted to regions that offer a relative abundance of that factor. To implement these hypotheses, the approach adopted by new economic geography and theories of knowledge spillovers allow us to establish a relationship between regional characteristics and industry traits.

Finally, our third hypothesis is related to industries characterized by low demand and a low intensity of technology. It can be stated as follows:

> H_3: Foreign direct investment in cost-oriented industries does not value agglomeration economies since these tend to increase costs due to competition for factor inputs (congestion costs).

DATA AND APPROACH

Studies of the variables influencing the location decisions of manufacturing foreign investment have been hindered by the failure to develop, to date, a structural model of FDI determinants that can identify which of these factors might be considered pivotal and which should, therefore, be included in any further analysis. Researchers have had to rely on empirical studies that offer only certain insights into these variables and the way that they behave and interact.

Empirical studies of multinational locational choices at the regional level have mainly examined entry into the U.S. markets (LUGER and SHETTY, 1985; COUGHLIN et al., 1991; WOODWARD, 1992; FRIEDMAN et al., 1992; HEAD et al., 1995 and 1999). Following, CARLTON (1983) and BARTIK's (1985) approach to branch plant location, most of these studies use discrete choice models to analyze new-investment decisions.

Similarly, a number of studies have examined the locational determinants of FDI within Europe. SCAPERLANDA and BALOUGH (1983) analyzed the locational determinants of US investment in the EEC; CULEM (1988) studied bilateral FDI flows between the USA and five European countries; THIRAN and YAMAWAKI (1995) focused on Japanese FDI in European countries and regions. HILL and MUNDAY (1991 and 1992) sought to identify FDI determinants in the United Kingdom, as did MARIOTTI and PRICITELLO (1995) in Italy, GUIMARAES et al. (2000) in Portugal, EGEA and LÓPEZ PUEYO (1991) and PELEGRÍN (2002) in Spain. With the exception of GUIMARAES et al. (2000), who adopted a discrete choice model approach for new plant investment, the other studies employed a multiple regression or panel data approach, using all forms of FDI, not just greenfield investment, as their dependent variable.

Here, our empirical implementation of the model is applied to the case of Spain. Spain experienced a rapid growth in FDI following its entry into the European Community in 1986. The country is an active recipient in the world flow of FDI, doubling its participation from 3.7% in the period 1981-1986 to 7% in 1991 (OECD, 1991). VENABLES et al. (2000) shows that at the beginning of the 1970s, 5.8% of all EU manufacturing was located in Spain. Over the last three decades this share has risen to 6.5%.

There is no doubt that an intensive process of spatial concentration occurred in the regional distribution of FDI in Spain during the nineties. Figure 1 depicts the geographical pattern of regional FDI in manufacturing industries compared to the geographical pattern of Spanish manufacturing industry, measured by the gross value added. The FDI curve shows the percentage of manufacturing FDI during the period 1995-2000 by region. Of the 17 regions, two - Madrid and Cataluña - received almost 70% of manufacturing investment. The question we wish to address is whether the geographic distribution of FDI is more concentrated than that of Spanish manufacturing industry. To determine this, we compare the two curves - FDI and Spanish manufacturing gross value added. Figure 1 shows that only in two regions, Cataluña and País Vasco, is the concentration pattern similar. The explanation for this would appear to lie in the fact that these two regions have a strong manufacturing tradition characterized by a great diversity of industries, and that here agglomeration economies serve to attract FDI. The case of Madrid is somewhat different, however. There is a tendency for foreign firms to locate in a region that operates as the economic and political centre, as information costs can be minimized when the state's administrative institutions and business services are readily accessible for FDI (HE, 2002). This strong core effect has been reported elsewhere in regional FDI studies (MARIOTTI and PISCITELLO, 1995; GUIMARAES et al., 2000; CROZET et al., 2004). All the other Spanish regions present a different pattern of concentration.

Insert Figure 1: Regional Manufacturing FDI and Regional Manufacturing Value Added

It is worth noting that the area of analysis here is perhaps too large for the accurate observation of agglomerations (see the map of regions included as Appendix 1, Figure 2). Indeed, a smaller area would be more appropriate were data to be available at that level. However, studies elsewhere have also used the region and/or the state to analyse the determinants of FDI, including agglomeration factors (COUGHLIN et al., 1991; HEAD et al., 1995 and 1999; SHAVER, 1998; CHUNG and ALCÁCER, 2002). Interestingly, HEAD et al. (1995 and 1999) measured agglomeration by not only considering state variables, but also the adjacent-state variable as they claimed that: "(…) state borders are rather arbitrary boundaries for the extent of agglomeration effects".

In the case of Spain, adopting the region as the unit of analysis has the advantage that any results can be used by regional public policy makers, whose decisions in this field are autonomous from those of central government. Thus, while it would be desirable to reduce the level of geographical aggregation, the data are not available. Yet, Spain is a good example of a country in which to study the way in which inter-industry differences result in different patterns of FDI location.

Manufacturing FDI depends on regional characteristics (location factors) and on industry traits (linkages, R+D intensity and costs), which quantify the extent to which specific industries concentrate in a certain territory. Below, we describe, first, how the dependent variable is constructed (as a proxy of FDI) and, second, we consider the proxy variables that are used in explaining the estimation of the econometric model.

The dependent variable

The measurement of a region's inward investment is no easy task. In Spain, foreign investment data broken down by regional destination is provided by the Department of Trade and Investment. Royal Decree 664/1999 introduced modifications to foreign investment, which in turn affected the availability of FDI statistics in Spain. The decree ruled that potential projects would no longer be subject to advance verification or authorization, but rather that firms would now have to declare foreign income to the Foreign Investments Registry (FIR) of the Spanish Ministry of Industry, Tourism and Commerce once it had been invested.[3] These changes mean that the information is now much more reliable as all foreign investments are registered (not just foreign investments subject to verification or authorization). An investment must be registered within a month of its having been made.

The Department of Trade and Investment's information is drawn from the FIR. In this information, it publishes the "registered gross foreign investment", which basically includes investments in branches and in share participations in non publicly quoted companies and in publicly quoted companies if capital participation equals or exceeds 10%.

In July 2003, the Department of Trade and Investment presented a new series of statistics, one of them was the "gross effective foreign investment" which is obtained by subtracting from the registered value of gross foreign investment the acquisitions of shares by foreign investors from other non residents in Spain, and the multiple accounting of this same operation caused by the restructuring of business groups in Spain. Clearly these two operations do not represent an increase in foreign assets in Spain. Unfortunately, these statistics do not distinguish between greenfield investment and acquisitions and so it is not possible to center the analysis solely on the former.

The paper considers the gross effective foreign investment as the nearest proxy of FDI for the period 1995-2000, for all manufacturing FDI and for five different industries: food and beverages; chemicals; transport equipment; paper, printing and publishing; and electric and electronic equipment. These five industries accounted for 70 per cent of all manufacturing FDI during this period. The variables are expressed per capita, divided by regional population, as an intensity measure, as in most empirical studies of FDI, and in real terms (see Appendix 2, Table 9).

Explanatory variables

Appendix 2, Table 9, includes a description of the explanatory variables. These variables serve as proxies for the regional characteristics believed to determine the choice of location. The regional characteristics considered in this paper are: market demand, labor market, manufacturing density, same industry activity, concentration of services and technical activity.

The variables related to market demand, including size and growth rate, have traditionally been considered critical determinants in host countries, and are frequently included in studies of FDI location. Their significance and value are expected to correlate positively with FDI. The most frequently used variable as a proxy of market demand is regional income (GDP),[4] though COUGHLIN et al. (1991) propose using manufacturing density. These authors point out that states with a high degree of manufacturing activity might attract foreign investors who are already serving existing manufacturers in the area. However, introducing these two proxies (GDP and manufacturing density) in the same regression model is problematic given that they are highly correlated, and thus it becomes difficult to disentangle the factors being measured, namely attraction to final consumers - which we try to proxy through GDP - and the agglomeration economies generated by forward and backward linkages (workers seek a location near the producers of consumer goods and producers want to concentrate where the market is largest).[5]

Table 1 shows the correlation matrix for the explanatory variables of FDI. Rather than using GDP, the variable introduced to proxy potential market demand is the yearly growth rate of consumption (Consum),[6] whose correlation with manufacturing density is very low (0.096), leaving manufacturing density to proxy agglomeration economies generated by forward and backward linkages. The lower correlation enables us to separate market size from agglomeration economies.

Insert Table 1: Correlation and characteristics of variables

Labor costs and human capital variables can be used to analyse the regional labor market. When technology levels and product quality are standardized, and cost is the priority, production may be transferred to another area with lower labor costs (VERNON, 1966). Thus, labor costs can act as a deterrent to FDI.[7]

However, elsewhere, labor costs would appear to have a significant positive correlation with FDI.[8] In these studies, it seems that labor costs reflect the availability of skilled workers in the region, acting as a proxy for qualifications and skills.

Here, two proxies for labor costs were used: a) the regional value of industrial wages per employee,[9] in real terms, and b) unit labor cost measured by the ratio of industrial wages to labor productivity (value added per employee), in real terms. However, the best results were obtained using the former. As hypothesis three suggests, a negative sign is expected in those industries that are very much cost oriented.

The availability of a skilled labor force is important in attracting FDI, especially in medium and high technology-intensive activities. PORTER (1988) claims that multinational firms attach greater value to the existence of labor with a good knowledge level than to a cheap labor market. Two proxies for human capital are used: the percentage of the labor force having completed secondary education, and the percentage of the labor force having completed higher education.

The variables that seek to proxy regional characteristics, such as manufacturing density, same industry density, concentration of services and technical activity are considered as agglomeration variables and the analysis of their role in the attraction of manufacturing FDI is our main focus here.

The presence of existing manufacturing activity in a region, with its large cluster of consumers and suppliers, has often been considered a significant factor in attracting firms whose demand for specialized labor and other inputs is low, but which seek to locate in areas with a strong industrial heritage. In line with hypothesis one, this regional characteristic attracts industries with a good level of inter-industry linkages showing the importance of manufacturing agglomeration in FDI location. Here, we use the manufacturing employment rate per square kilometre as a proxy of manufacturing density.

HOOVER (1936) identified two major types of agglomeration economies: location economies and urbanisation economies. Location economies or externalities derive from industry-specific location, obtained when firms in the same industry share a pool of skilled labor and specialized input suppliers, so that there are economies external to the firm but internal to the industry. This increases the efficiency of production and generates strong forward and backward linkages in an area. The proxy for this external economy is the share of regional industrial employment in each sector. As hypothesis one already states, industries with intra-industry linkages are attracted to regions with location economies. Urbanisation economies, in which the economies are external to the industry but internal to the territory, benefit all the firms in the area. In this second case, the economies are generally related to the concentration of services (professional, banking and communication services, and the provision of scientific and technological assets) in urban areas. The variable that best measures the urbanisation economies is the concentration of services and the proxy for this variable is the share of total regional employment in tertiary sectors divided by share of total national employment in tertiary sectors.

Knowledge is an important source of ownership advantage for multinationals investing in foreign regions and countries, and so R+D spending may not represent a barrier to foreign firms (DRIFFIELD and MUNDAY, 2000). On the contrary, it may be an attraction. As a proxy for this variable we used three regional data sources: the number of patents, as a measure of innovative output; the firms' internal expenditure on research and development activities, assumed to be a key input in generating new knowledge; and the number of researchers in the firms (full time or equivalent) over active population, as a proxy of R+D activity. The three data sources gave very similar results, however the number of researchers provided the most significant estimation. In line with hypothesis two, this proxy is expected to be positive and significant in industries that have a high R+D intensity, thereby demonstrating the importance of agglomeration by technical activity in FDI location.

Finally we introduced a variable to control for regional comparative advantages, which cause agglomeration due to the differences between regions in endowment of natural resources, labour and infrastructure. To proxy this variable we obtained a regional comparative advantage index, such as in BARRY, GÖRG, and STROBL, (2003) and in HEAD, RIES, and SWENSON, (1995). As BARRY, GÖRG, and STROBL, (2003) postulate: "all other things equal, foreign firms should be expected to locate where factor endowments are favourable", then the sectorial distribution of Spanish-owned firms should reflect this kind of information. We calculated an employment specialization index as the ratio of the share of sector j employment in region i over total manufacturing employment in region i, in Spanish-owned firms, relative to the same share for Spain (including domestic and foreign-owned firms).

$$C.Advan_{it} = \frac{E^{S}_{ijt} \Big/ \sum_j E^{S}_{ijt}}{E^{NF}_{jt} \Big/ \sum_j E^{NF}_{jt}}$$

where E^{S}_{ijt} is employment in Spanish-owned firms in region i and in sector j, and E^{NF}_{jt} is employment in both domestic and foreign-owned firms in sector j in Spain. The datasource was obtained on request from the Industrial Firms Survey, a survey conducted by the National Institute of Statistics. Data were only available for firms with 20 or more workers. Around 25,000 firms were represented altogether.

METHODOLOGY AND ESTIMATION RESULTS

Methodology

Given the fact that we have access to panel data, as well as cross-sectional and temporal information, the methodology adopted for the model estimation is that specifically designed for panel data.

The data provide information for 17 regions over a six-year period (1995-2000). The model estimated is the individual effect with panel data, that is:

$$y_{it} = \alpha + x_{it}\beta + \alpha_i + \nu_{it}, \tag{1}$$

where y_{it} is the dependent variable measured in region i=1,...N for the year t=1;...,T, x_{it} is a row vector of explanatory variables, α_i describes the individual effect for the regions and ν_{it} is the random error, which is normal with mean 0 and variance σ_ν^2. In our case, the dependent variable is $y_{it} = FDI_{it}$ for all the manufacturers or $y_{it} = FDI\_Ind.Name_{it}$ for the specific industries, the explanatory variable vector x_{it} is equal to:

$$\begin{gathered}(Consum_{it}, Wage_{it}, Second.Edu._{it}, High.Edu._{it}, Manufac.Density_{it},\\ Locali\_Ind.Name_{it}, Serv.Density_{it}, R\,\&\,D_{it}, C.Advan\_Ind_{it})\end{gathered}$$

for specific industries, and without the variable $Locali\_Ind.Name_{it}$ for all the manufacturers. All variables, dependent and explanatory, are expressed in logarithms.

The estimation of the model expressed in (1) depends on the α_i characteristics. If we suppose that α_i is a constant for each region, then we can estimate the fixed effect model, that is, the model with binary variables for each region or the model expressed in differences with respect to the mean for each region. In both cases the estimation uses the ordinary least squares (OLS) technique.

The property of the fixed effect estimation is consistency rather than efficiency. This lack of efficiency in the fixed effect estimation may imply that the estimated parameters are not significant. The efficient estimation is obtained for the random effect model.

The random effect model supposes that α_i is a random variable with a normal distribution, whose mean is 0 and whose variance is σ_α^2. The random error in this model is $u_{it} = \alpha_i + \nu_{it}$, the variance and covariance matrix of u_{it} error is not spherical, in this case we use a generalized least squares or weighted least squares (GLS or WLS) estimation to obtain the parameter estimates.

This estimation is efficient but might not be consistent if the explanatory variables are not independent of random error. This would cause the values of the estimated parameters to be very different from those of the true parameters. We calculated the χ^2 statistic associated with Hausman inference. This statistical test compares the value and variance of the estimated parameters between the two individual effect models: fixed and random effects. When the differences between parameters are great and the differences between variances are small, the Hausman statistic is large and significant and the fixed effect model is preferred. When the opposite is the case, the random effect model is preferred. As the statistic associated with Hausman inference is not significant for most of the models estimated here, only the results of random effects models are presented.

Estimation Results

The results presented in this section appear in Table 2, which includes all manufacturers, and in Tables 3 to 7, which include the five selected industries. In the industries analysis four models were estimated: model 1 includes all the variables described in Appendix 2, Table 9, while in model 2 the variable High Education (High.Edu) was eliminated. In model 3, together with High.Edu, we eliminated the proxy of comparative advantage (C.Advan) and in model 4, together with High.Edu, we eliminated agglomeration in the same industry activity (Locali).

Table 2 presents the baseline model. In model 1 none of the parameters associated with all the variables were significant. In model 2, in which the variable High.Edu was eliminated, the parameters were not significant either. However, as the Hausman test was not consistent, we estimated the fixed effect model; once again, the parameters were not significant. In previous research, similar models have been used to model all the industries together, with the implicit assumption of industry homogeneity. In these cases the results are therefore essentially an average effect. It is difficult to analyse the economic meaning of these results as they present an average effect. An estimation for each industry allow us to analyse this matter further.

Insert Table 2: Estimation results for all the manufacture (dependent variable FDI)

The empirical results obtained from the regression analyses for the specific industries appear in Tables 3 to 7.

We are now in a position to establish relationships between the industry traits and our hypotheses. In terms of our first hypothesis, the firm traits we are concerned with are forward and backward linkages. VENABLES et al. (2000) identify industries with high, medium and low intra-industry and inter-industry linkages.[10] Here, therefore, transport equipment, chemicals, paper, printing and publishing, and food and beverages show a high level of linkages (intra-industry and inter-industry), while electric and electronic show a medium level of linkages.

In terms of our second hypothesis, CHUNG and ALCÁCER (2002) identify the industries with the highest R+D intensity as pharmaceuticals,[11] semiconductors, chemicals, and electronics/electrical equipment. Another interesting classification of R+D intensity industries is that provided by the OECD, which would consider our chosen industries as follows: pharmaceuticals and electronic equipment - high technology; transport equipment, chemicals, and electrical equipment - medium-high technology, and finally food and beverages, paper, printing and publishing - low technology.

In terms of our third hypothesis, cost-oriented industries can be considered as traditional industries, with low technology intensity (OECD classification) and with low dynamism in demand. From our chosen industries, this would include food and beverages, paper, printing and publishing.

Table 3 presents the results for the food and beverage industries. The parameter associated with the Wage variable is negative and significant. The same result is obtained for the parameter associated with the Second.Edu (secondary education) variable. Both results indicate the importance attached to low labor costs by the food and beverages industry. In models 1 and 2, the variable Locali (same industry activity) and the variable C.Advan (comparative advantage) are presented together. Their parameters were significant, though Locali was negative and C.Advan positive. When we separated the variables (in models 3 and 4), their parameters were not significant, proving that in this industry the relevant variable was labor cost.

Insert Table 3: Estimation results for Food-Beverage industry

In paper, printing and publishing (also cost-oriented industries, Table 4), the results of models 1 and 2 do not allow us to make conclusions because of multicollinearity. In model 3 the parameters associated with the variables Locali and Manufac. Density were positive and significant, as was the parameter of the variable C.Advan in model 4. However model 4 had a better fit, proving that even though agglomeration factors are significant location drivers, this industry is mainly oriented by favourable factor endowments.

Insert Table 4: Estimation results for Paper-Printing-Publishing industry

Table 5 shows the results of the models estimated for the transport industry, the parameters associated with Second.Edu. and Locali (same industry activity) appear positive and significant. However the parameter associated with the Wage variable is negative and significant. This suggests that foreign entrants in the transport sector are likely to respond negatively to increases in labour costs. The same is true for the chemical industry, in Table 6, in this industry the parameters associated with the variables Locali and R+D are positive and significant. Our results show that the chemical industry prefers regions with the same industry activity and high R+D density.

Insert Table 5: Estimation results for Transport industry

Insert Table 6: Estimation results for Chemical industry

Table 7 shows the results for electric and electronic industry. In models 1 and 2, in which the variables Locali and C.Advan are presented together, the multicollinearity problems generated do not allow us to make conclusions, but in model 3 the parameter associated with the Locali variable was positive and significant. The parameter of C.Advan in model 4 was also positive and significant (as in paper, printing and publishing). In this case model 3 had a better fit than model 4. Moreover the Hausman test showed that model 4 was not consistent. We therefore estimated the fixed effect model, but the parameters were not significant. As a result, agglomeration in the same industry activity (Locali) is the most relevant location factor in this industry.

Insert Table 7: Estimation results for Electric-Electronic industry

Thus, the location pattern of R+D intensive industries are consistent with the MAR approach (Marshall, Arrow and Romer) as they all show positive and significant location economies. Similar findings are reported by MAURSETH and VERSPAGEN (2002) and by CANTWELL and PISCITELLO (2005), however they do not distinguish between specific industries.

As Table 5-6-7 shows, in transport, chemical and electric and electronic sectors intra-industry linkages are positive and significant, suggesting that the location decision in these industries is highly influenced by the potential for capturing intra-industry spillovers.

Finally, the first three columns in Table 8 show the industry traits, while the last three columns show the relationship between the results obtained in the five industries analysed and the hypotheses considered in section 2. As the table illustrates, our estimation results prove that most of the industries fulfil the established hypotheses. Transport equipment and chemical industries fully support the hypotheses. Electric and electronic industries satisfy the first hypothesis since they are attracted to regions with high producer activity, but we found no evidence for the second hypothesis since they were not attracted to regions with high R&D activity. Finally, food and beverages, and paper, printing and publishing, cost-oriented industries, attach more importance to endowment reasons, a resource orientation related to the third hypothesis.

Insert Table 8: Industry Traits and Hypotheses

CONCLUDING REMARKS

Agglomeration factors have not always been included among the determinants of FDI location. Indeed, most empirical studies working with data from the '60s, '70s and early '80s found that FDI was, at that time, mainly in greenfield form and resource- and market-oriented. However, during the last two decades, FDI has undergone gradual changes and as it has become more and more oriented towards strategic assets, such as intellectual capital, its location needs have also changed. In the case of strategic investment, whose objective is to maintain and increase ownership advantage, the external economies generated by agglomeration factors have increased their weight in location decisions. Furthermore, the economic and institutional facilities offered by these new locations have also grown in importance. Thus, as Dunning (1998) suggests, while globalisation separates ownership and the location of production geographically, agglomeration forces concentrate activity within particular regions and countries.

This study has sought to analyze the role that industry traits play in the regional location of FDI. Differences in the traits of industries, such as R+D intensity, demand and linkages, result in varying propensities to agglomerate. Regional characteristics, particularly those that foster agglomeration economies, act as attractive location factors in function of these industry traits.

The methodology used here is specific for panel data. The model estimated is the individual regional effect for all manufactures and for the five industries. The Hausman inference statistic indicates that the random effect model in the industry analysis was consistent and efficient.

A number of the questions raised in the introduction can be immediately answered from our results. First, agglomeration economies prove to be determinant location factors for

FDI; three out of the five industries analysed show positive and significant values for the parameters associated with the agglomeration variables. Second, the study finds that the agglomeration effect that is most present as a location determinant is the presence of the same industry activity in the territory. Third, not all the industries are attracted by the same agglomeration factors and, therefore, the nature and importance of FDI location determinants varies with the specific needs of each industry.

Our results show that industries with a high level of intra- and inter-industry linkages, with the exception of cost-oriented industries, are attracted to regions characterized by the same industry activity. Moreover, locations with a high intensity of R+D activities attract chemical industries. Only cost-oriented industries such as food and beverages and paper, printing and publishing do not value agglomeration economies. Their localization emerges due to endowment reasons.

Once we have established that locations with high level on R&D activities attract high technology industries, it would be interesting to compare the R+D intensity of foreign firms operating in R+D intensive industries with that of their Spanish counterparts. MARTIN (1999) sheds a certain degree of light on this question by comparing the R+D expenses of firms in Spain, the European Union (15 countries) and the United States for the period 1986-1998. The author finds that the R+D intensity of European Union firms is, on average, more than twice that of Spanish firms, while that of the U.S. firms is three times the R+D intensity recorded in Spain. The author points out that this difference is concentrated mostly in technology intensive industries. Interestingly, the European Union countries accounted for 68% and the U.S. for 23% of FDI during the period 1995-2000.

These differences in R+D intensity between Spanish and foreign firms within the same industry, appear to indicate that seeking domestic knowledge is not a FDI location determinant in these industries, but foreign knowledge flows are attracted to the regions with better local innovation systems, as Madrid and Cataluña. In this sense, it might be argued that FDI in R+D intensive industries is attracted to regions in order to exploit their firm specific-capabilities in foreign environments, rather than to augment them, but the regional profile of specialization is determinant for the multinationals' innovations activities. Spanish regions do not generate sufficient knowledge externalities to attract firms that need to augment their knowledge base, but they attract firms that want to exploit their capabilities. Regions with a high concentration of activity in chemical and electric and electronic equipment industries attract FDI in the same industries, proving the importance of knowledge spillovers within the same industry.

The findings reported here have a number of implications. This paper demonstrates that regional characteristics are valued differently according to the characteristics of a given industry, and thus new entrants tend to compare the industry traits of previous foreign entrants when seeking a new site. In this way, they are able to benefit from the experience of previous foreign investors. For policy makers concerned with promoting FDI, manufacturing agglomeration - especially location economies and R+D activities, is a key characteristic in attracting manufacturing FDI to a territory. The paper also suggests that if public policy makers wish to shift gradually from FDI in R+D intensive industries oriented towards exploiting these firms' capabilities to FDI oriented more towards augmenting their R+D capabilities, then they need to create an attractive local innovation system. This can be achieved primarily by providing an efficient scientific base.

As CANTWELL and IAMMARINO (2003) propose, public intervention at the level of regional system should support the endogenous capacity to produce knowledge and to absorb knowledge generated outside the region and, on the other hand, should increase the attractiveness of the region in order to capture global flows of innovation. The way to achieve both objectives seems to be cooperation through physical flows of inputs and outputs, exchange of information, knowledge and expertise. Supporting regional technology agencies, consortia, entrepreneurs' associations and a systematic public-private cooperation may secure a sufficient collective learning capacity.

In the European Union, where national boundaries are steadily becoming less and less significant, regional factors would appear to be gaining in importance as determinants of investment location. This increases the need for further regional empirical research in many areas. One such line of study would be the analysis of the role of regional incentives in location decisions, while another would be to explore the role that specific foreign agglomeration economies play as location factors. Finally, further research is required into understanding the location preferences for plant investment.

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Notes

1- This phenomenon is reflected in the increasing number of mergers and takeovers.

2- This paper does not focus on this specific kind of FDI agglomeration as this would require a knowledge of the exact number of establishments or plants. Alternatively, the annual stock of accumulated manufacturing FDI might be drawn on, but these figures are not available.

3- Except in some special cases of investment originating from tax havens, in which case the declaration has to be made prior to the investment.

4- SCAPELANDA and BALOUG (1983), CULEM (1988), HEAD et al. (1999); WOODWARD (1992), THIRAN and YAMAWAKI (1995), MARIOTTI and PISCITELLO (1995), CHUNG and ALCÁCER (2002), BAJO-RUBIO and LÓPEZ-PUEYO (2002). All these studies reported a positive and significant correlation between GDP and FDI.

5- HEAD et al. (1999) reported a correlation between demand (GDP) and manufacturing agglomeration of 0.9, and MARIOTTI and PISCITELLO (1995) recorded a strong correlation between the metropolitan areas of Milan and Rome and R+D, wages and market.

6- MARIOTTI and PISCITELLO (1995) and BAJO-RUBIO and LÓPEZ-PUEYO (2002) use per capita consumption as a proxy for market demand. In both cases a positive and significant correlation was found with FDI.

7- BARTIK (1985), LUGER and SHETTY (1985), HILL and MUNDAY (1991) and COUGHLIN et al. (1991) reported a negative and significant correlation between wages and FDI.

8- HEAD et al. (1999), THIRAN and YAMAWAKI (1995) and GUIMARAES et al. (2000) obtained a significant positive correlation between wages and FDI.

9- Wages include all labor costs such as unemployment, illness and disability insurance costs.

10- VENABLES et al. (2000) identify the characteristics for 13 EU countries and 36 industries from 1970 to 1997, using the OECD STAN database and OECD input-output tables' database. Among others, the industry traits comprise economies of scale, technology level (high, medium and low), intra-industry linkages (use of intermediates from own sector as share of value of production) and inter-industry linkages (use of intermediates excluding inputs from own sector, as share of value of production).

11- Those industries whose R+D spending/sales are over 5% for OECD nations.

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APPENDIX 1

Insert Figure 2: Map of Spanish Regions

APPENDIX 2

Insert Table 9: Description of Variables and Constructs

Table 1: Correlation and characteristics of variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Consum (1)	1.00	-0.12	0.19	0.02	0.10	0.25	-0.16	0.21	0.18	-0.11	-0.18	-0.20	0.33	0.29	0.16	-0.04	-0.01	-0.18
Wage (2)	-0.12	1.00	0.33	0.31	0.50	0.09	0.70	-0.59	0.41	0.57	0.41	0.70	-0.50	-0.63	0.30	0.36	0.51	0.63
Second.Edu. (3)	0.19	0.33	1.00	0.17	0.47	0.38	0.23	-0.36	0.16	-0.03	0.13	0.24	0.05	-0.36	0.20	0.13	0.31	0.12
High.Edu. (4)	0.02	0.31	0.17	1.00	0.45	0.31	0.51	-0.49	0.52	0.33	0.45	0.54	-0.18	-0.40	0.48	0.19	0.31	0.63
Manufac.Density (5)	0.10	0.50	0.47	0.45	1.00	0.27	0.57	-0.65	0.56	0.30	0.20	0.42	-0.17	-0.54	0.59	0.42	0.39	0.43
Serv.Concentration (6)	0.25	0.09	0.31	0.31	0.27	1.00	-0.14	0.07	0.66	-0.22	-0.15	0.09	0.18	0.03	0.56	-0.12	-0.13	0.11
R&D (7)	-0.16	0.70	0.23	0.51	0.57	-0.14	1.00	-0.82	0.30	0.55	0.56	0.74	-0.60	-0.63	0.31	0.38	0.57	0.75
Locali_Food (8)	0.21	-0.59	-0.36	-0.49	-0.65	0.07	-0.82	1.00	-0.28	-0.49	-0.26	-0.65	0.46	0.86	-0.30	-0.41	-0.32	-0.69
Locali_Paper (9)	0.18	0.41	0.16	0.52	0.56	0.66	0.30	-0.28	1.00	0.21	-0.01	0.37	-0.22	-0.19	0.84	0.19	0.11	0.53
Locali_Transp (10)	-0.17	0.57	-0.03	0.33	0.30	-0.22	0.55	-0.49	0.21	1.00	0.40	0.57	-0.28	-0.45	0.04	0.68	0.56	0.63
Locali_Chemic (11)	-0.18	0.41	0.13	0.45	0.20	-0.15	0.56	-0.26	-0.01	0.40	1.00	0.67	-0.47	-0.22	0.12	0.31	0.81	0.54
Locali_Electr (12)	-0.20	0.70	0.24	0.54	0.42	0.09	0.74	-0.65	0.37	0.57	0.67	1.00	-0.64	-0.53	0.43	0.29	0.66	0.84
C.Advanc._Ind (13)	0.33	-0.50	-0.05	0.18	-0.17	0.18	-0.60	0.46	-0.22	-0.28	-0.47	-0.64	1.00	0.31	-0.42	-0.24	-0.35	-0.59

C.Advanc._Food (14)	0.29	-0.63	-0.36	-0.40	-0.54	0.03	-0.63	0.86	-0.19	-0.45	-0.22	-0.53	0.31	1.00	-0.17	-0.26	-0.28	-0.54
C.Advanc._Paper (15)	0.16	0.30	0.20	0.48	0.59	0.56	0.31	-0.30	0.84	0.04	0.12	0.43	-0.42	-0.17	1.00	0.11	0.20	0.44
C.Advanc._Transp (16)	-0.04	0.36	0.13	0.19	0.42	-0.12	0.38	-0.41	0.19	0.68	0.31	0.29	-0.24	-0.26	0.11	1.00	0.40	0.43
C.Advanc._Chemic (17)	-0.01	0.51	0.31	0.31	0.39	-0.14	0.57	-0.32	0.11	0.56	0.81	0.66	-0.35	-0.28	0.20	0.40	1.00	0.44
C.Advanc_Electr (18)	-0.18	0.63	0.11	0.63	0.43	0.11	0.75	-0.69	0.53	0.63	0.54	0.84	-0.59	-0.54	0.44	0.43	0.44	1.00

Table 2: Estimation results for all the manufacture (dependent variable FDI)

Variable		Model 1	Model 2
Intercept		-3.193	-3.012
Consum		-12.063	-11.899
		(-0.710)	(-0.700)
Wage		-2.370	-2.393
		(-1.000)	(-1.020)
Second.Edu.		-1.150	-1.258
		(-0.440)	(-0.490)
High.Edu.		0.338	
		(1.010)	
Manufac.Density		0.557	0.618
		(-1.560)	(1.800)
Serv.Concentration		-1.649	-1.142
		(-0.820)	(-0.590)
R&D		0.278	0.405
		(0.840)	(1.290)
C.Advan.		-4.123	-3.941
		(-1.540)	(-1.500)
	Hausman Test	12.420	16.660**
	R-Square	0.1499	0.1469

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 3: Estimation results for Food-Beverage industry

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	-10.094	-9.878	-5.920	-5.718
Consum	-21.844	-20.167	-1.311	-20.466
	(-0.480)	(-0.450)	(-0.030)	(-0.450)
Wage	-9.659	-10.120	-14.513	-13.633
	(-1.940*)	(-2.080**)	(-2.920***)	(-2.660***)
Second.Edu.	-13.343	-13.673	-13.415	-11.938
	(-2.390**)	(-2.480**)	(-2.240**)	(-2.000**)
High.Edu.	0.259			
	(-0.460)			
Manufac.Density	0.456	0.465	0.580	0.977
	(0.720)	(0.740)	(0.790)	(1.410)
Locali	-5.763	-5.824	-1.738	
	(-2.279**)	(-2.300**)	(-0.910)	
Serv.Concentration	3.549	4.399	3.763	2.915
	(0.810)	(1.110)	(0.860)	(0.670)
R&D	0.988	1.108	1.626	2.091
	(1.200)	(1.420)	(2.090**)	(3.170***)
C.Advan.	4.589	4.493		0.889
	(2.270**)	(2.240**)		(0.590)

Hausman Test	5.870	6.020	5.420	5.700
R-Square	0.274	0.271	0.188	0.187

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 4: Estimation results for Paper-Printing-Publishing industry

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	-4.889	-1.697	3.689	-4.681
Consum	3.841	5.142	6.358	5.390
	(0.080)	(0.100)	(0.130)	(0.110)
Wage	0.625	2.664	-0.663	3.853
	(0.080)	(0.330)	(-0.090)	(0.500)
Second.Edu.	5.995	6.637	6.481	6.318
	(0.760)	(0.830)	(0.800)	(0.790)
High.Edu.	2.725			
	(2.300**)			
Manufac.Density	1.696	1.910	2.597	1.984
	(1.240)	(1.220)	(1.850*)	(1.250)
Locali	1.421	1.939	6.117	
	(0.380)	(0.490)	(2.060**)	
Serv.Concentration	-13.608	-13.595	-13.196	-12.659
	(-2.020**)	(-1.980**)	(-1.910*)	(-1.960**)
R&D	-1.630	-1.201	-1.000	-1.260
	(-1.680*)	(-1.230)	(-1.030)	(-1.290)
C.Advan.	4.657	6.508		7.864
	(1.250)	(1.570)		(2.430**)

Hausman Test	9.050	8.370	5.720	7.970
R-Square	0.219	0.159	0.147	0.155

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 5: Estimation results for Transport industry

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	10.964	12.855	11.766	4.380
Consum	-76.085	-73.806	-78.051	-83.411
	(-1.210)	(-1.180)	(-1.250)	(-1.330)
Wage	-18.756	-19.271	-18.818	-13.582
	(-1.970**)	(-2.040**)	(-2.070**)	(-1.490)
Second.Edu.	16.598	17.037	16.653	12.921
	(1.660*)	(1.710*)	(1.710*)	(1.310)
High.Edu.	1.235			
	(0.920)			
Manufac.Density	2.029	2.319	2.085	2.149
	(1.360)	(1.610)	(1.630*)	(1.430)
Locali	3.446	3.929	3.390	
	(1.520)	(1.800*)	(2.120**)	
Serv.Concentration	3.632	5.481	5.825	3.934
	(0.470)	(0.730)	(0.800)	(0.520)
R&D	0.150	0.481	0.697	0.646
	(0.130)	(0.420)	(0.630)	(0.550)
C.Advan.	-0.134	-0.259		0.664
	(-0.170)	(-0.330)		(1.020)

Hausman Test	11.130	12.380	9.370	13.430
R-Square	0.151	0.145	0.155	0.110

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 6: Estimation results for Chemical industry

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	1.864	3.884	2.498	-3.207
Consum	4.005	9.632	0.536	-14.239
	(0.070)	(0.180)	(0.010)	(-0.260)
Wage	-15.453	-15.798	-17.643	-16.162
	(-2.230**)	(-2.280**)	(-2.570***)	(-2.170**)
Second.Edu.	5.169	5.185	3.261	1.850
	(0.650)	(0.660)	(0.420)	(0.220)
High.Edu.	1.049			
	(1.030)			
Manufac.Density	1.131	1.408	0.962	0.869
	(1.100)	(1.420)	(1.000)	(0.810)
Locali	4.579	5.492	3.125	
	(2.200**)	(2.930***)	(2.560***)	
Serv.Concentration	3.359	5.384	6.994	5.635
	(0.540)	(0.910)	(1.190)	(0.890)
R&D	2.288	2.569	2.683	2.980
	(2.350**)	(2.740***)	(2.850***)	(3.050***)
C.Advan.	-3.171	-3.892		1.343
	(-1.280)	(-1.650*)		(0.790)

Hausman Test	11.330	12.550	12.080	16.430**
R-Square	0.273	0.266	0.249	0.167

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 7: Estimation results for Electric-Electronic industry

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	1.040	4.900	4.993	-0.726
Consum	-6.376	4.319	6.596	-16.817
	(-0.110)	(0.080)	(0.120)	(-0.300)
Wage	-6.322	-7.806	-7.966	-5.038
	(-0.870)	(-1.050)	(-1.060)	(-0.700)
Second.Edu.	10.252	10.754	9.502	11.594
	(1.260)	(1.290)	(1.160)	(1.400)
High.Edu.	1.568			
	(1.580)			
Manufac.Density	1.232	1.514	1.581	1.506
	(1.260)	(1.490)	(1.530)	(1.500)
Locali	2.560	3.179	4.112	
	(1.310)	(1.580)	(2.420**)	
Serv.Concentration	5.428	7.545	2.42	8.129
	(0.870)	(1.210)	(1.310)	(1.310)
R&D	-0.046	0.104	0.255	0.448
	(-0.040)	(0.100)	(0.250)	(0.430)
C.Advan.	0.635	1.104		2.334
	(0.450)	(0.790)		(2.000**)

Hausman Test	10.300	10.630	10.720	12.450*
R-Square	0.260	0.222	0.210	0.209

Number in parentheses are t-statistics. Significant at: ***p<0.001, **p<0.05, *p<0.10

Table 8: Industry Traits and Hypotheses

<table>
<tr><th>Industry</th><th>Technology level</th><th>Intra-industry linkages</th><th>Inter-industry linkages</th><th>H_1</th><th>H_2</th><th>H_3</th></tr>
<tr><td>Food and Beverages</td><td>L</td><td>M</td><td>H</td><td>No</td><td></td><td>Yes</td></tr>
<tr><td>Paper
Printing & Publishing</td><td>L</td><td>H</td><td>L</td><td>No</td><td></td><td>Yes</td></tr>
<tr><td>Transport Equip.
- Motor vehicles
- Motorcycles</td><td>M
M</td><td>H
L</td><td>M
H</td><td>Yes</td><td></td><td></td></tr>
<tr><td>Chemicals
- Ind. Chemicals
- Drugs&Medicines</td><td>M
H</td><td>H
L</td><td>L
H</td><td>Yes</td><td>Yes</td><td></td></tr>
<tr><td>Electronic Equip.</td><td>H</td><td>M</td><td>L</td><td rowspan="2">Yes</td><td rowspan="2">No</td><td rowspan="2"></td></tr>
<tr><td>Electric Equip.</td><td>H</td><td>M</td><td>M</td></tr>
</table>

H: High, M: Medium, L: Low

Source: Industry Traits are from VENABLES et al. (2000)

Table 9: Description of Variables and Constructs*

Dependents Variables	Measure	Period 1995-2000, constant terms of 1995
FDI	Manufacturing Foreign Direct Investment	Gross Effective Foreign Investment in manufacturing industry
FDI_Ind.Name	Specific Industry Foreign Direct Investment	Gross Effective Foreign Investment in each of the five industries
Explanatory Variables		Period 1995-2000, constant terms of 1995
Consum	Potential Market Demand	Yearly growth rate of consumption
Wage	Labor Cost	Manufacturing wages per manufacturing wage earner
Second.Edu.	Human capital: Secondary education	Share of labor supply with secondary education
High.Edu.	Human capital: High education	Share of labor supply with High education
Manufac.Density	Manufacturing Density	Manufacturing employment per square kilometer
Locati_Ind.Name	Same Industry Activity: Location Economies	Share of regional industrial wage earners in the same industry

Serv.Concentration	Concentration of Services: Urbanization Economies	Share of total regional employment in tertiary sectors divided by share of total national employment in tertiary sectors
R&D	Technical Activity Agglomeration	Number of firms' researchers over active population in each region
C.Advan	Comparative Advantage	Share of sector j employment in region i over total manufacturing employment in region i, in Spanish-owned firms, relative to the same share for Spain (including domestic and foreign-owned firms).

*Sources:

- Department of Trade and Investment (Ministry of Industry): Foreign Investment in Spain, Gross Effective Foreign Investment Series.
- "Contabilidad Regional de España" (Regional Accounting of Spain) in Instituto Nacional Estadística (National Institute of Statistics).
- "Renta Nacional de España y su Distribución" (National Income of Spain and its Distribution) in BBVA Foundation.
- Alcaide Inchausti, J; Alcaide Guindo, P; (2002). "Avance de las magnitudes económicas en el 2001 y serie provisional del balance económico regional" (Economic data for 2001 and provisional series of economic regional balance), 1995-2001, in Cuadernos de Información Económica, No. 167, pp. 1-54.

- Mas, M; Perez, F; Uriel, E; Serrano, L; (2002). "Las series de capital humano 1964-2001" (Human capital series 1964-2001), in Capital Humano y Actividad Económica, Bancaja Foundation.

- Encuesta Industrial de empresas (Industrial Firms Survey) in Instituto Nacional Estadística (National Institute of Statistics).

Figure 1. Regional Manufacturing FDI and Regional Manufacturing Value Added

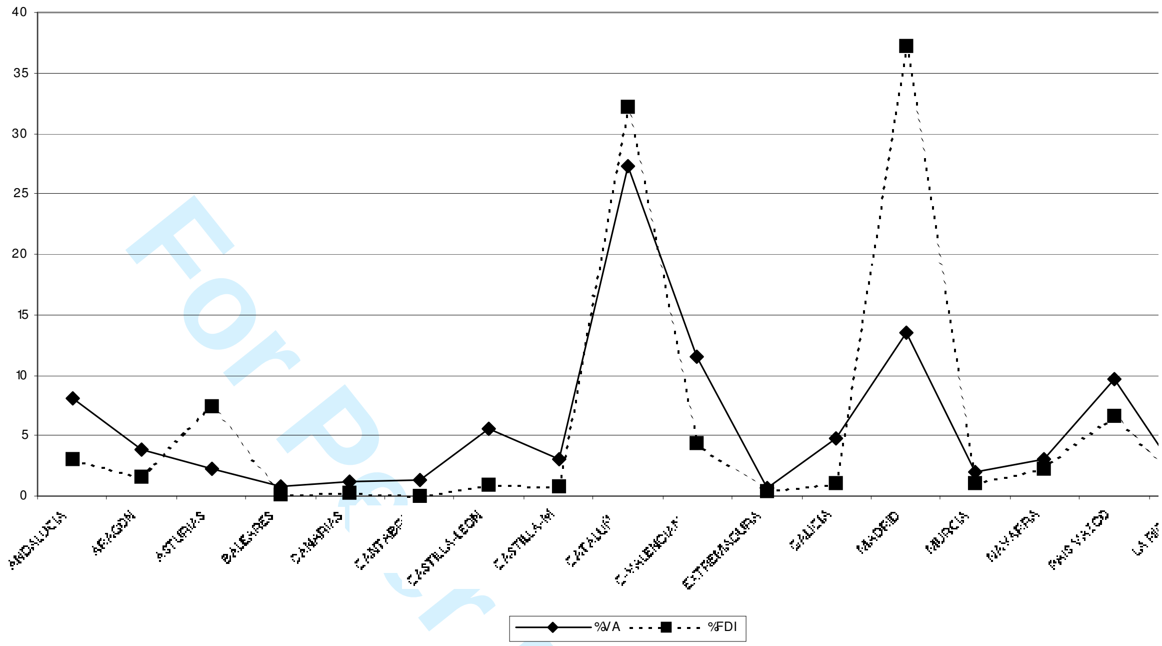

Figure 2: Map of Spanish Regions